

REMARKS

This application has been reviewed in light of the Office Action dated September 6, 2001. Claims 1-24 are pending in this application. Claims 19-24 have been added to provide Applicants with a more complete scope of protection. Claims 1, 11, and 18 have been amended to define still more clearly what Applicants regard as their invention, in terms that distinguish over the art of record. Claims 1, 11, and 18-24 are in independent form. Favorable reconsideration is requested.

First, Applicants gratefully acknowledge the indication that Claims 4, 6, 14, and 16 include allowable subject matter and would be allowable if rewritten in proper independent form. As described below, Applicants traverse the rejection of independent Claims 1 and 11 and therefore have not so rewritten Claims 4, 6, 14, and 16 at this time. However, Claims 19-22 include the allowable subject matter from Claims 4, 6, 14, and 16, respectively, and are allowable.

The Office Action rejected Claims 1, 3, 5, 7-11, 13, 15, 17, and 18 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,164,756 (Takahashi et al.) in view of U.S. Patent No. 6,003,970 (Fujita et al.), and Claims 2 and 12 as being unpatentable over Takahashi et al. in view of Fujita et al. and U.S. Patent No. 5,384,587 (Takagi et al.). Applicants respectfully traverse these rejections.

The aspect of the present invention set forth in Claim 1 is an ink jet printing apparatus for forming an image on a print medium by using a print head, the print head having a plurality of nozzle groups, each having a plurality of nozzles for printing a same color. The ink jet printing apparatus performs a plurality of main scans by scanning the ink jet head relatively with respect to a main scan print area of the print medium and forms the image onto the same main scan print area by using different nozzle groups in the plurality of scanning operations. In this apparatus, different thinning out mask patterns are used in

the plurality of scanning operations for printing onto the same main scan print area, and a thinned out image according to the different thinning out mask patterns is formed onto the same main scan print area by the different nozzle groups during the plurality of scanning operations. The apparatus also divides the same scan print area into a plurality of divided areas in a sub-scan direction that is different from a main scan direction, and determines the printing duty of each of the plurality of divided areas, the printing duty being determined from the thinning out mask pattern. Moreover, the apparatus performs the thinning out process by the thinning out mask pattern so that the printing duty of one of the divided areas and the printing duty of another of the divided areas are different from each other.

Among other important features of Claim 1 are that when the same main scan print area is printed by performing a plurality of scanning operations using different nozzle groups for printing a same color, the apparatus uses different thinning out mask patterns in a plurality of scanning operations for printing onto the same main scan print area, and a printing duty corresponding to one divided area is different from a printing duty corresponding to another divided area, when performing a thinning out process by a thinning out mask pattern.

As an explanatory example of the operation of such an apparatus, suppose that the same main scan print area is a first print area shown in Figure 14B. In the first print area, a thinned out image is formed in a first scan using a first thinning out mask pattern (composed of an upper portion of 12.50% and a lower portion of 25.00%); a thinned out image is formed in a second scan using a second thinning out mask pattern (composed of an upper portion of 25.00% and a lower portion of 37.50%); a thinned out image is formed in a third scan using a third thinning out mask pattern (composed of an upper portion of 37.50% and a lower portion of 25.00%); and a thinned out image is

formed in a fourth scan using a fourth thinning out mask pattern (composed of an upper portion of 25.00% and a lower portion of 12.50%). Based on this example, Applicants submit that in a plurality of scanning operations for printing the same main scan print area (a first print area), different thinning out mask patterns (the first thinning out mask pattern to the fourth thinning out mask pattern) are used. In addition, in each scan, as printing duties corresponding to divided areas (the divided areas being represented by reference numerals e1 and e2) are formed by dividing the main scan print area (the first print area) in a sub-scan direction, a printing duty corresponding to one (e1) of the divided areas is different from that of the other (e2) of the divided areas, when a thinning out process is carried out by the thinning out mask pattern.

More specifically, a thinning out process is carried out in a manner such that i) in the first scan, a printing duty of the divided area e1 is set at a value of 12.5% and a printing duty of the divided area e2 is set at a value of 25.00%; ii) in the second scan, a printing duty of the divided area e1 is set at a value of 25.00% and a printing duty of the divided area e2 is set at a value of 37.50%; iii) in the third scan, a printing duty of the divided area e1 is set at a value of 37.50% and a printing duty of the divided area e2 is set at a value of 25.00%; and iv) in the fourth scan, a printing duty of the divided area e1 is set at a value of 25.00% and a printing duty of the divided area e2 is set at a value of 12.50%.

In addition, when printing on each of the divided areas, the printing duties become different from each other in a plurality of scans. For example, printing on the divided area e1 is performed by setting printing duties at values of 12.50%, 25.00%, 37.50%, and 25.00% in the first scan, the second scan, the third scan, and the fourth scan, respectively. Thus, this example shows that printing duties have different values in a

plurality of scans.¹

Takahashi et al. relates to an apparatus for detecting whether there is a boundary between a black image and a color image. If a boundary exists, then multi-pass printing which can record the image at a relatively low speed is set; if a boundary does not exist, then normal printing at a relatively high speed is set. In Takahashi et al., a same one area is 1-pass printed until the 2nd scan, as shown in Figure 6. From the 3rd scan on and thereafter, a same one area is 3-pass printed. In addition, as shown in Figure 13, in Takahashi et al., the pass number can be varied. However, nothing in Takahashi et al. would teach or suggest *using different thinning out mask patterns* as a thinning out mask pattern to be used in 3-pass for printing a same one area. In addition, nothing in Takahashi et al. would teach or suggest effecting a thinning out process by a thinning out mask pattern in a manner such that printing duties corresponding to a plurality of divided areas formed by dividing the same main scan print area in a sub-scan direction are different from each other and that printing duties are different in a plurality of scans when printing on respective divided areas by performing a plurality of scanning operations. Furthermore, the Office Action states (and Applicants agree) that Takahashi et al. does not teach thinning out mask patterns, that the thinning out mask pattern has a lower resolution than of an image being printed, that an amount of ink ejected from each nozzle of the printhead in one ejection operation is 4 pl or less, that the printed dots have an average diameter of 50 μm or less, and that the print density is 600 dpi or higher.

Fujita et al. relates to a recording head that uses eight nozzles, where the apparatus feeds paper by an amount equal to two nozzles at each recording scan, and a recording is made with respect to first and second rasters in a first recording scan by #7 and

¹/(It is to be understood, of course, that the scope of Claim 1 is not limited to the details of this example, which is referred to only for purposes of illustration.)

#8 nozzles. In Fujita et al., printing is effected by "a sequential multi-scan", which is a technique of assigning one line data equally to respective nozzle for equalization of the frequency of using each of the nozzles, when printing in one line using different nozzles in a plurality of scans. Applicants submit that this technique of assigning data in the sequential multi-scan is different from the thinning out mask pattern, as recited in Claim 1, and nothing in Fujita et al. would teach or suggest using different thinning out mask patterns in a plurality of scanning operations for printing onto the same main scan print area. In addition, in Fujita et al., the apparatus employs the sequential multi-scan technique, which means that when effecting printing in one line in a plurality of scans, printing is effected at the same printing duty in each scan. In contrast, as recited in Claim 1, printing duties are different in a plurality of scans when printing on each of divided areas by performing a plurality of scan operations.

Applicants submit that, at least for the reasons discussed above, the proposed combination of Takahashi et al. and Fujita et al., assuming such combination would even be permissible, would still fail to teach or suggest that when the same main scan print area is printed by performing a plurality of scanning operations using different nozzle groups for printing a same color, the apparatus uses different thinning out mask patterns in a plurality of scanning operations for printing onto the same main scan print area, and a printing duty corresponding to one divided area is different from a printing duty corresponding to another divided area, when performing a thinning out process by a thinning out mask pattern, as recited in Claim 1. Accordingly, Applicants submit that Claim 1 is patentable over these two patents (if more than two state "this prior art"), taken separately or in any proper combination.

Independent Claims 11, 18, and 24 are method claims, and Claim 23 is an apparatus claim, that correspond to apparatus Claim 1, and are believed to be patentable for

at least the same reasons as discussed above in connection with Claim 1.

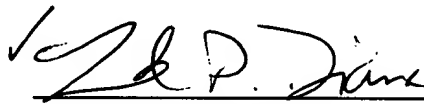
A review of the other art of record, including Takagi et al., has failed to reveal anything that, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as applied against the independent claims herein. Therefore, those claims are respectfully submitted to be patentable over the art of record.

The other rejected claims in this application depend from one or another of the independent claims discussed above, and, therefore, are submitted to be patentable for at least the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, individual consideration or reconsideration, as the case may be, of the patentability of each claim on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

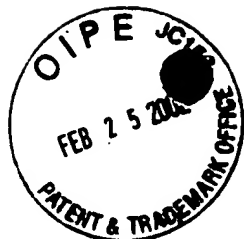
Applicants' undersigned attorney may be reached in our New York Office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address listed below.

Respectfully submitted,


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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. (Amended) An ink jet printing apparatus for forming an image on a print medium by using a print head, the print head having a plurality of nozzle groups, each having a plurality of nozzles for printing a same color, the ink jet printing apparatus comprising:

an image formation means for performing a plurality of main scans by scanning the ink jet head relatively with respect to [on one and the] a same main scan print area of the print medium [using different nozzle groups] and for forming the image onto the same main scan print area by using different nozzle groups of the ink jet head in the plurality of scanning operations [and for forming a thinned out image according to a thinning out mask pattern in each of the plurality of main scans to complete an image], wherein different thinning out mask patterns are used in the plurality of scanning operations for printing onto the same main scan print area, and a thinned out image according to the different thinning out mask patterns is formed onto the same main scan print area by the different nozzle groups during the plurality of scanning operations; and

a printing duty determining means for dividing the same [main scan print area at a predetermined pitch in a sub-scan direction different from a main scan direction and for determining printing duties of the divided areas determined by the thinning out mask pattern to different values] scan print area into a plurality of divided areas in a sub-scan direction different from a main scan direction, and for determining the printing duty of each of the plurality of divided areas, the printing duty being determined from the thinning out mask pattern,

wherein the printing duty determining means performs the thinning out process by the thinning out mask pattern so that the printing duty of one of the divided areas and the printing duty of another of the divided areas are different from each other.

11. (Amended) An ink jet printing method for forming an image on a print medium by using a print head, the print head having a plurality of nozzle groups, each having a plurality of nozzles, the ink jet printing method comprising the steps of:

performing a plurality of main scans by scanning the ink jet head relatively with respect to [on one and the] a same main scan print area of the print medium [using different nozzle groups] and forming the image onto the same main scan print area by using different nozzle groups of the ink jet head in the plurality of scanning operations, [and forming a thinned out image according to a thinning out mask pattern in each of the plurality of main scans; and] wherein different thinning out mask patterns are used in the plurality of scanning operations for printing onto the same main scan print area, and a thinned out image according to the different thinning out mask patterns is formed onto the same main scan print area by the different nozzle groups during the plurality of scanning operations, and

dividing the same [main scan print area at a predetermined pitch in a subscan direction different from a main scan direction and setting printing duties of the divided areas determined by the thinning out mask pattern to different values] scan print area into a plurality of divided areas in a sub-scan direction different from a main scan direction, and

determining the printing duty of each of the plurality of divided areas, the printing duty being determined from the thinning out mask pattern,

wherein, the printing duty of one of the divided areas and the printing duty of another of the divided areas are different from each other.

18. (Amended) A printing control method for an ink jet printing apparatus, the ink jet printing apparatus having a plurality of nozzle groups, each having a plurality of nozzles, the printing control method comprising the steps of:

providing the printing apparatus;

performing a plurality of main scans by scanning the ink jet head relatively with respect to [on one and the] a same main scan print area of the print medium [using different nozzle groups] and forming the image onto the same main scan print area by using different nozzle groups of the ink jet head in the plurality of scanning operations, [and forming a thinned out image according to a thinning out mask pattern in each of the plurality of main scans; and] wherein different thinning out mask patterns are used in the plurality of scanning operations for printing onto the same main scan print area, and a thinned out image according to the different thinning out mask patterns is formed onto the same main scan print area by the different nozzle groups during the plurality of scanning operations, and

dividing the same [main scan print area at a predetermined pitch in a subscan direction different from a main scan direction and setting printing duties of the divided areas determined by the thinning out mask pattern to different values] scan print area into a

plurality of divided areas in a sub-scan direction different from a main scan direction, and
determining the printing duty of each of the plurality of divided areas, the printing duty being
determined from the thinning out mask pattern,

wherein, the printing duty of one of the divided areas and the printing duty
of another of the divided areas are different from each other.

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